

UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 32.

[In order to render the results of investigations and experiments conducted by the Agricultural Department of the University of California more quickly and more generally available than has heretofore been done through the annual or biennial reports, it is proposed to embody hereafter, in the form of "Bulletins," to be issued as often as may seem desirable, reports of results, as well as such other discussions, information or answers to questions as may be of general interest. It is intended to make these bulletins, as a rule, short enough for insertion in the daily or weekly papers of the State, and proof-slips of the same will be regularly mailed to papers applying therefor. The substance of these bulletins will ultimately be embodied in a more complete and connected form, in the annual reports of the College of Agriculture.]

Examinations of Well and Spring Waters.

1. *Water from a bored well*, five miles west of Fresno city, at the vineyard of Dr. John Hastings. The proprietor states in regard to this well, that it is 105 feet in depth, the water rising within 12 feet of the surface. The supply is so large that a steam pump, with a three-inch suction pipe, cannot sensibly reduce the water.

The water is clear and tasteless, though evidently hard; it is slightly alkaline when fresh.

The solid contents amount to 22.3 grains per gallon; of the residue there is again

Grains.

Soluble in water.....	7.1
Insoluble.....	9.1
Volatile (water and organic matter).....	6.1

The soluble part is still slightly alkaline, and consists in the main of the sulphate and chloride of sodium, or Glauber's and common salts, with some gypsum (sulphate of lime), and small amounts of the sulphates of potash and magnesia, a trace of carbonate of soda.

The insoluble part consists chiefly of carbonate of magnesia, with some carbonate of lime and silica.

This water is well adapted to irrigation, since so large a proportion of its solid contents consists of lime and magnesia. For domestic use its hardness can be abated by boiling or by the use of about one-tenth of its bulk of lime water, when most of the lime and magnesia will be thrown down as a white sediment. It is similar in this respect to the waters of the Mission San Jose, described in a previous bulletin (No. 20), save in so far as it contains more magnesia instead of lime, and might in the course of time affect persons having weak digestion.

Former examinations made on the spot have shown that all well waters near Fresno contain a large amount of lime, with some magnesia, which are deposited on boiling. Thus at the Central Colony, at Mr. T. C. White's. A sample of the *crust deposited in a boiler* by the water on his place, near Fresno, was sent by Mr. B. Marks. The deposit, which was hard and almost glassy-looking, proved to be composed, in about equal proportions, of the carbonates of lime and magnesia. It stands probably, therefore, in the same category as Mr. White's; both can be deprived of their excess of earthy ingredients, for domestic purposes, by the use of lime water. The latter can be readily kept on hand in a barrel into which a handful of lime has been thrown; after filling with water and stirring, the water will in a short time become clear again, and can then be mixed with the well water which it is desired to soften, in such proportions as may be found adequate. This proportion usually varies between one to eight and one to fifteen, and can readily be ascertained by any one, by trying successively larger measures of lime water, until the well water does not show any more turbidity on the addition of more lime water, after allowing is to settle. The incrusting of kettles can thus be prevented, and delicate stomachs that resent the presence of magnesia, relieved.

Water from an artesian well on the land of Mr. J. H. Hoskins, south of Lake Tulare:—Sent by Dr. S. F. Chapin, of San Jose. The depth and exact location of this well are not given. The water is clear and tasteless.

Grains.

Total solid contents per gallon.....	7.8
Again soluble after evaporation.....	5.0
Insoluble ".....	1.2
Water and organic matter.....	1.6

The soluble part consists of a mixture of chloride, sulphate and carbonate of soda, the latter least in amount.

The insoluble part consists in the main of carbonate of lime, with a little magnesia and silica.

The mineral contents of this well water are remarkably low, especially if, as is presumable, located near Tulare Lake. It resembles more nearly a river than a well water of the region, and may be considered well suited to all purposes, whether for irrigation or domestic use.

This case seems to confirm the presumption raised in other cases, that excellent artesian water can be obtained in the Tulare region, provided that the influx of the alkaline waters from higher levels be completely excluded by tight tubing.

Water from the artesian well at the Stockton Asylum for the Insane.—It will be remembered

that the analysis of what was supposed to be this water was reported in a previous bulletin (No. 20). It has since appeared that the water then analyzed was from another well (Salmon's), supposed to be of the same character, but much stronger in salts than the asylum well. A sample of the latter has since been sent by Mr. W. M. Fitzhugh, ass't State engineer; and while the ingredients of the water were found to be nearly the same in kind as those of the former water, they are very much less in quantity. The data stand as follows:

	Grains.
Total solid contents per gallon	36.6
Again soluble after evaporation	25.4
Insoluble	6.5
Organic matter and water	4.7

As the water of Salmon's well contains 209 grains of salts, it will be noted that the difference in favor of the asylum well water is very considerable, although the amount of salts present is still so great for most purposes.

Water from a well at the Napa Asylum for the Insane, by Dr. L. F. Dozier—This is a dug well, of no great depth; has been used for some time, and it has been suggested that it might be contaminated with sewage. The water is clear and tasteless; rather hard. On evaporation it left a residue amounting to 16 grains per gallon, of which 9.9 grains were again soluble, and 6.1 grains insoluble. The latter part consists in the main of the carbonates of lime and magnesia, with a little gypsum. The soluble part consists prevalently of chloride of sodium, or common salt; also a little of Glauber's salt or sulphate of soda, and chloride of magnesium or bitters.

A close examination showed the absence of nitrates, ammonia salts, or of any objectionable kind or proportion of organic matter. The saline ingredients of the well are simply derived from tide water in Napa Slough, and are not present in excessive proportions.

Water from a surface well near Hueneme, Ventura county; sent by E. O. Gerbering, with the following information:—"The water tastes well, but my neighbors say that such water is highly injurious, not only to plants watered with it but also to the land. I am just starting a berry patch, and need water to irrigate; the well is close by and contains sufficient water for my purpose, but I am afraid to use it until I hear from you. To get artesian water would require an outlay of some \$350, which I naturally desire to avoid."

The water is clear but has a somewhat flatish taste, and is very hard:

Grains.

Total solid contents per gallon	68.3
Again soluble after evaporation	29.4
Insoluble after evaporation	29.6
Organic matter and combined water	6.3

The soluble part consists of the chlorides and sulphates of soda, lime and magnesia, the former predominating. The insoluble part consists of the carbonates of lime and magnesia, with some gypsum and silica.

The latter portion would not be objectionable so far as the land is concerned; but nearly thirty grains of saline ingredients to the gallon is more than can safely be used on any soils but those that can be well drained from time to time, so as to wash out the soluble "alkali" salts. The water is not strong enough to injure plants *directly*, but only through the accumulation of the alkali by repeated use and evaporation from the surface. When this can be avoided, even such waters as those of Tulare lake are available; and many worse waters are used in India, with the proper precautions.

Waters from Arrowhead Hot Springs, near San Bernardino; sent by Messrs. Durby & Lyman, the proprietors. There are four springs, of which those mentioned below are the chief.

Spring No. 1—The water is slightly alkaline when fresh; is clear and colorless.

Grains.

Total solid contents per gallon	70.9
Again soluble after evaporation	53.0
Insoluble after evaporation	12.2
Organic matter and combined water	5.7

The soluble part consists chiefly of sulphate of soda or Glauber's salt, with common salt or chloride of sodium, a little gypsum or sulphate of lime, and a very small amount of carbonate of soda. The insoluble part consists chiefly of silica, with small amounts of the carbonates of lime and magnesia.

Spring No. 2—General appearance and properties of water the same as in No. 1.

Grains.

Total solid contents per gallon	66.0
Again soluble after evaporation	53.2
Insoluble after evaporation	9.3
Organic matter and combined water	3.5

In kind, the ingredients of this water do not seem to differ materially from those of No. 1.

From this composition it appears that both waters are light purgatives, of moderate strength. The high temperature of these springs, and the sulphuretted hydrogen which several of them carry in addition to the saline ingredients (but which had not been preserved in the specimens examined), of course add materially to the medicinal effects.

Berkeley, Feb. 12, 1885. E. W. HILGARD.